EFFECT OF CATTLE GRAZING ON UNDERSTORY VEGETATION AT PALO VERDE NATIONAL WILDLIFE REFUGE

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Abstract. (NDP) Since 1987, cattle have been excluded by fence from sections of Palo Verde National Wildlife Refuge. In 1995, we examined the impact of this management plan on understory vegetation. Densities of stems >75 cm tall and woody seedlings <2 m tall were both significantly higher in the ungrazed than in the grazed area. In addition, we found the morphotype richness of woody seedlings to be 50% higher in ungrazed areas. Thus, the exclusion of cattle in tropical dry forests has significant affects on the growth and species composition of the vegetation and should be considered when designing and management plans.

INTRODUCTION (VRL, IJS)

The effects of cattle grazing have been an important issue in the management of Palo Verde National Wildlife Refuge, Costa Rica. For many years, the entire marsh area and much of the dry forest was grazed by cattle (Gill 1988). To protect the park, grazing was eliminated in February 1981. However, the species composition of the marsh began to change, with cattails (*Typha* sp.) beginning to exclude other species. A decision was made in 1987 to re-introduce cattle into the marsh and a small amount of nearby forest, separating these areas from the surrounding park with barbed-wire fences. This aspect of management has been controversial because the detailed effects of cattle on marsh and dry forest ecology are not fully documented.

The purpose of our study was to examine the impact of this cattle management plan on the vegetation by comparing grazed and ungrazed areas. Since cattle can graze on vegetation under 2 m, we hypothesized that tall plants (>75 cm) and photosynthetic matter will be less abundant in grazed areas. If cattle are eating woody seedlings, we expected the density of woody seedlings <2 m tall to be lower in grazed than ungrazed habitats which may influence tree dynamics. Lastly, since many woody species are intolerant of cattle grazing, we hypothesized lower diversity of woody morphotypes in the grazed area.

METHODS (NDP)

On 9 January 1995, we examined ground vegetation on both sides of a cattle fence approximately 1 km east of the OTS Biological Station in Palo Verde National Wildlife Refuge, near the road to Bagaces. We sampled a total of 40 0.83 m^2 plots (20 grazed and 20 ungrazed), evenly spaced along a 200 m transect parallel to the fence and >30 m away from the road. Plots were 5 m from the fence to eliminate effects of disturbances associated with it. The "ungrazed" (north) side of the fence had not been grazed since 1981, while the "grazed" (south) side had been accessible to cattle for many years prior to 1981 and since 1987. Nevertheless, the south side shows little visible indication of recent grazing. Canopy cover above both the grazed and ungrazed plots were similar, so we did not stratify samples by canopy cover.

Within each plot, we recorded: (1) the percentage of photosynthetic ground cover <1 m tall in <1%, 1-5%, 5-25%, 25-50%, and >50% classes; (2) the number of all stems (woody and herbaceous) > 75 cm tall; and (3) the number of woody seedlings (excluding lianas) <2 m tall. In addition, we collected leaf samples from all woody seedlings for morphotyping to determine the number of different woody morphotypes in both the grazed and ungrazed areas.

RESULTS (VRL, IJS)

We condensed our cover classes to <5%, 5-25%, and 25-50%. To eliminate zero values in a grazed/ungrazed versus percent cover contingency table. There was no significant difference in the percent of ground cover between grazed and ungrazed plots (G=1.269, df=2, P=0.530, Fig. 1).

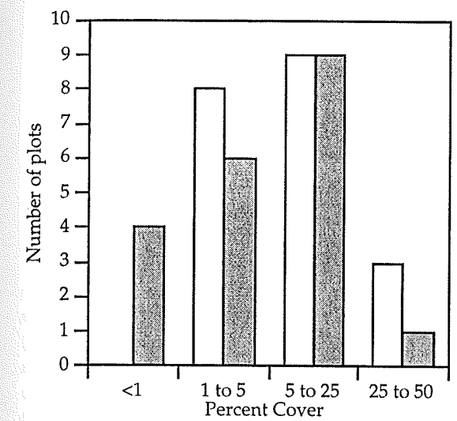

FIG. 1. Ground cover of all plants <1 m tall in grazed (grey bars, n=20) and ungrazed (white bars, n=20) plots at Palo Verde, Costa Rica. There is no significant association between grazed/ungrazed and percent cover (P>0.5, see text).

The density of stems >75cm was significantly lower in grazed than in ungrazed plots (t=4.0, df=19, P=0.001, Fig. 2). The density of woody seedlings under 2m was significantly higher in ungrazed than in grazed plots (t=24.5, df=19, P=0.002, Fig. 2).

There were 15 morphotypes of woody seedlings in the grazed plots compared to 30 species in the ungrazed plots, with only three morphotypes in common.

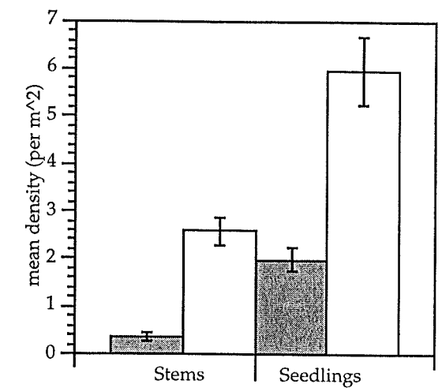

FIG. 2. Density of stems (woody and herbaceous) >75cm and of woody seedlings <2 m high (means ± 1SE) in grazed (grey bars, n=20) and ungrazed (white bars, n=20) plots at Palo Verde, Costa Rica. There were significant differences for both categories (stems P=0.001; seedlings P=0.002, see text).

DISCUSSION (WLO, CDW)

Although cattle graze low level vegetation, they may stimulate production of new tissue in grasses and thus compensate for the reduction in cover of woody plants. This may explain the lack of difference in percent cover between the grazed and ungrazed plots. The grazed area appeared to have higher grass cover while woody seedlings and lianas appeared to dominate in the ungrazed area, but we did not quantify these.

The lower density of stems >75 cm (woody and herbaceous) and woody seedlings <2 m in the grazed area is probably due to cattle eating seedlings. The low density of woody seedlings may also be due to indirect grazing effects. For example, if non-woody vegetation is more abundant in grazed habitats, woody seedlings might experience more competition, resulting in decreased woody seedling survival. Although we didn't quantify the relative amount of non-woody morphotypes, the grazed area did appear to have more grasses that the ungrazed habitat.

Cattle grazing decreased the number of species, yet since only three morphotypes are common to both areas, total woody morphotype richness may be greatest when both ungrazed and grazed plots are maintained. Since cattle graze out their preferred species, only those morphotypes that are resistant to grazing survive. If these morphotypes are outcompeted in ungrazed areas, a management strategy permitting grazing in limited areas increases overall morphotype richness as expected by the intermediate disturbance hypothesis (Connell 1978). Thus, Palo Verde may support more species under its current controlled grazing policy than with either uncontrolled grazing or total grazer exclusion.

LITERATURE CITED

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Connell, Joseph H. 1978. Diversity in tropical rain forests and coral reefs. Science 199:1302-1309.